Space Weather Technical Forecast

Issued on Wednesday, 21 February 2024 at 12:50 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Ongoing chance of Moderate solar activity.

Solar Activity: Solar activity has been Low throughout with only mid-range C-class flares observed from various different places on the disc - including both the east and west limbs, and AR3590. This is a large region, showing development in its intermediate spots, although this could also be due to it rotating into a clearer viewing angle. There are now just two sunspots on the visible disc. The other, AR3586, briefly developed a weak opposite polarity leading spot. We are also starting to see signs of the returning region ex-3575 near the southeast limb, which may increase the risk of flaring over the next couple of days.
No Earth-directed CMEs have been observed in the last 24 hours.

Solar Wind / Geomagnetic Activity: Solar winds, as observed at L1 by ACE, have been at ambient speeds throughout, although with a slight increase in magnetic field. The wind speeds have varied between 270-320 km/s, with a gradual increase in recent hours to around 350 km/s. Density has been below average. Total magnetic field strength has been weak to moderate, below 10nT. The north-south component was mainly weakly negative at first, with a negative peak of -8nT, before becoming mostly northward directed. Phi angle was mainly positive (away from the Sun). Geomagnetic activity was mainly Quiet, with one Unsettled interval between 20/2100-2400 UTC.

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux was just above normal background levels but well below the S1/Minor Radiation Storm threshold. Electron flux (greater than 2MeV) observed at GOES16 has been at normal background levels, with electron fluence well below the Active (1e8 integrated pfu) threshold. The observed 24-hour fluence at 21/0001UTC was 1.06e6 integrated pfu.

Four-Day Space Weather Forecast Summary
Solar Activity: Low activity is forecast, but with an increasing chance of Moderate activity from AR3590, perhaps also from the likely ex-3575 region just over the southeast limb.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are forecast over the next four days. Solar winds are at ambient levels, but with a slightly increased magnetic field. This may be due to a very weak high speed stream from a previously undetected small coronal hole, but wind speeds are unlikely to exceed 400 km/s. Wind speeds are expected to remain at or below 400 km/s for much of the period, before coronal hole 01 potentially connects with Earth late on Day 4 (24 February), or perhaps after the end of this period, based on an estimated speed of 450-500km/s.
Geomagnetic activity is forecast to be mainly Quiet to Unsettled, with a slight chance of Active late on 24 February under any high speed stream influence.

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux will continue to gradually ease towards resting background levels, with a very low risk of an increase during this period.
High energy electron flux (greater than 2MeV) is expected to remain at normal background

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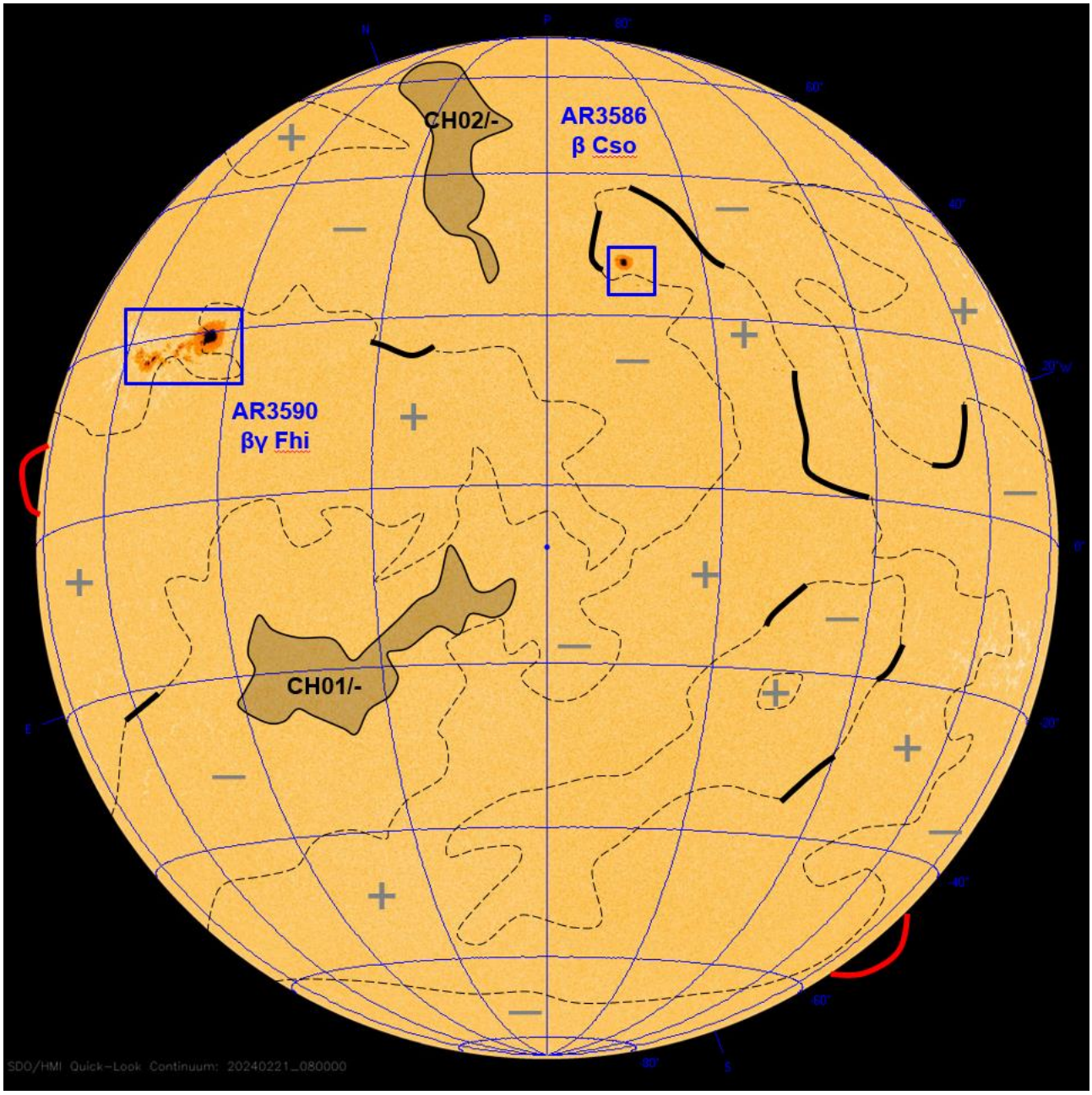
levels. 24-hour electron fluence is expected to stay below the Active (1e8 integrated pfu) threshold.

Figure 1. Solar Analysis Valid 21/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Met Office Space Weather Technical Forecast

Geomagnetic Storms:

No Earth-directed CMEs are forecast over the next four days.

Solar winds are at ambient levels, but with a slightly increased magnetic field. This may be due to a very weak high speed stream from a previously undetected small coronal hole, but wind speeds are unlikely to exceed 400 km/s. Wind speeds are expected to remain at or below 400 km/s for much of the period, before coronal hole 01 potentially connects with Earth late on Day 4 (24 February), or perhaps after the end of this period, based on an estimated speed of 450-500km/s. The high speed stream reached close to 500km/s from the equivalent feature on the last rotation, however there was only a limited geomagnetic response and the feature is slightly smaller on this occasion. That said, it is a negative polarity coronal hole which is becoming more favoured for a geomagnetic response as we get closer to the March equinox.

Geomagnetic activity is forecast to be mainly Quiet to Unsettled, with a slight chance of Active late on 24 February under any high speed stream influence.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

No Earth directed CMEs expected.

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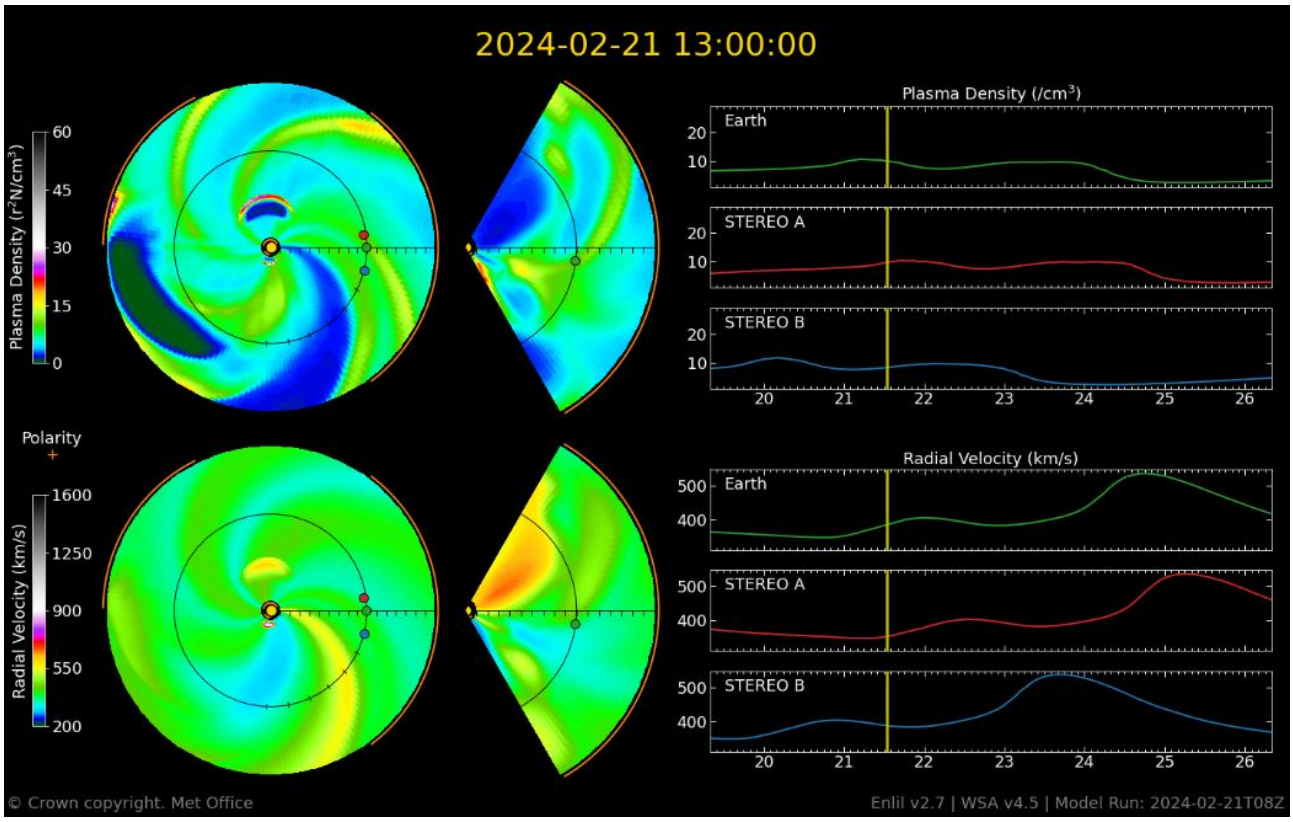
Figure 2: MOSWOC Enlil, showing a weak wind speed increase today which may be linked to the weak HSS we currently appear to be experiencing, followed by a stronger increase later in the period likely linked to CH01.



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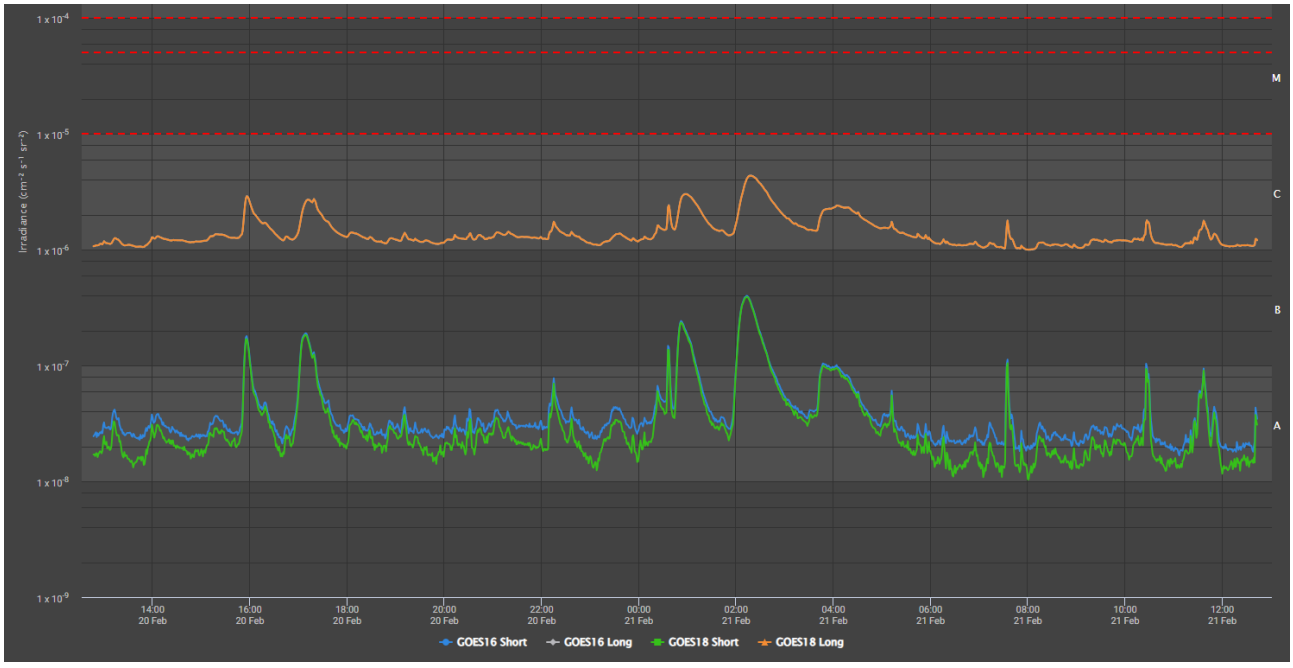
Radio Blackouts - X-Ray Flares:
Solar activity has been Low throughout with only mid-range C-class flares observed from various different places on the disc - including both the east and west limbs, and AR3590.

There are now just two sunspots on the visible disc, with AR3581 rotating over the limb and AR3584 fading as it approaches the limb. AR3590 is a large region, showing development in its intermediate spots, although this could also be due to it rotating into a clearer viewing angle. AR3586 has started to develop a weak opposite polarity leading spot. We are also starting to see signs of what is likely to be the returning region ex-3575 near the southeast limb, which may increase the risk of flaring over the next couple of days.

Low solar activity is forecast, with an increasing chance of M-class flares, predominantly from AR3590 at first, but with a slight increase indicated due to the likely return of ex-3575 which has appeared to be active with several large and fast CMEs observed as it transited across the far side of the Sun.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	35	40	45	45
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: X-ray flux at GOES16 and 18, showing only C-class flares in the last 24 hours.



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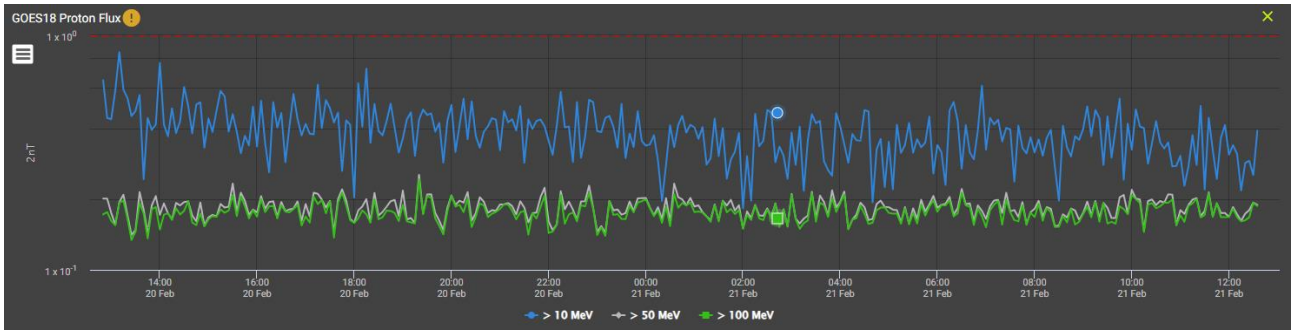
Solar Radiation Storms - (High Energy Protons):
GOES18 high energy (greater than 10MeV) protons are continuing to edge towards background levels, but currently remain slightly elevated above normal background.

Ex-AR3576 will has now reached near W150, well over the limb, and therefore presents a much reduced risk of radiation storms. AR3590, despite the large and complex arrangement is not currently in a position to cause a significant proton risk, but this will start to increase as it approaches centre disc by the end of Day 4 (24 Feb). The risk of proton storms is therefore likely to start to increase later in the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	2	1	1	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Proton flux at GOES18, showing 10MeV protons just very slightly above resting background levels.



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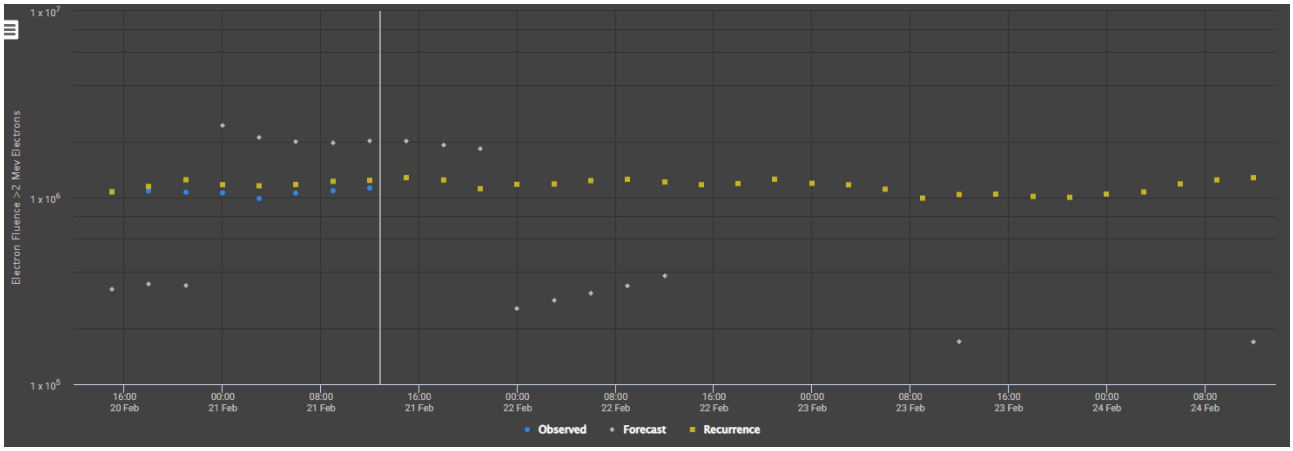
High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) is expected to remain at background to moderate levels throughout the period, with so significant inputs from the solar wind currently forecast. Electron fluence is expected to remain well below the Active (1e8 integrated pfu) threshold.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	1	1
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: MOSWOC REFM showing a well below Active fluence forecast.



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